SAMSUNG ELECTRONICS

**Approval**

TO :

DATE : November. 13. 2007

*SAMSUNG TFT-LCD*

# MODEL NO. : LTS480WS-C01

Customer Approval

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*Any Modification of Spec is not allowed without SEC's permission.*

Approved by : *Se chun, Oh*

**AMLCD DIVISION**

**Samsung Electronics Co . , LTD.**

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# Revision History

Approval

| Data | Rev. No. | Page | Summary |
|---|---|---|---|
| 2007.11.13 | 000 | | First issued. |

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## General Description

### * Description

LTS480WS-C01 is a transmissive type color active matrix TFT (Thin Film Transistor) LCD (Liquid Crystal Display) that uses LTPS (Low Temperature Poly-Silicon) TFT as a switching devices. This model is composed of a TFT-LCD module (TFT-LCD panel and FPC). The resolution of a 4.8" contains 1024 x RGB x 600 dots and can display up to 262k colors.

### * Features

- LTPS SOG (System-On-Glass) technology
- 4.8 inches 15.4:9 aspect ratio
- WSVGA (1024 x RGB x 600) resolution
- 262k colors (for production only)
- LVDS interface
- TMR (Transmissive with micro-reflectance) display mode
- TN mode with wide viewing angle film
- LED backlight unit
- 4-wire resistive film/glass type touch screen panel (TSP)

### * Applications

- Display terminals for Ultra mobile PC (UMPC), Potable CNS

### * General Information

| Items | Specification | Unit | Note |
|---|---|---|---|
| Display area | 104.45(H) x 61.20(V) | mm | - |
| Driver element | LTPS TFT active matrix | - | - |
| Display colors | 262k | colors | - |
| Number of dots | 1024(H) x 600(V) | dots | - |
| Pixel arrangement | RGB stripe type | - | - |
| Dot size | 34(H) x 102(V) | um | - |
| Display mode | Normally white, TMR mode | - | - |
| Viewing Direction | 12 | o'clock | - |

### * Mechanical Information

| Item | | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Model size | Horizontal(H) | 111.75 | 112.05 | 112.35 | mm | w TSP, w Component |
| | Vertical(V) | 72.96 | 73.26 | 73.56 | mm | w TSP, w Component |
| | Depth(D) | 5.48 | 5.68 | 5.88 | mm | w TSP, w Component |
| Weight | | - | 65 | 70 | g | w TSP, w Component |
| | | - | 51 | 56 | g | w/o TSP, w Component |

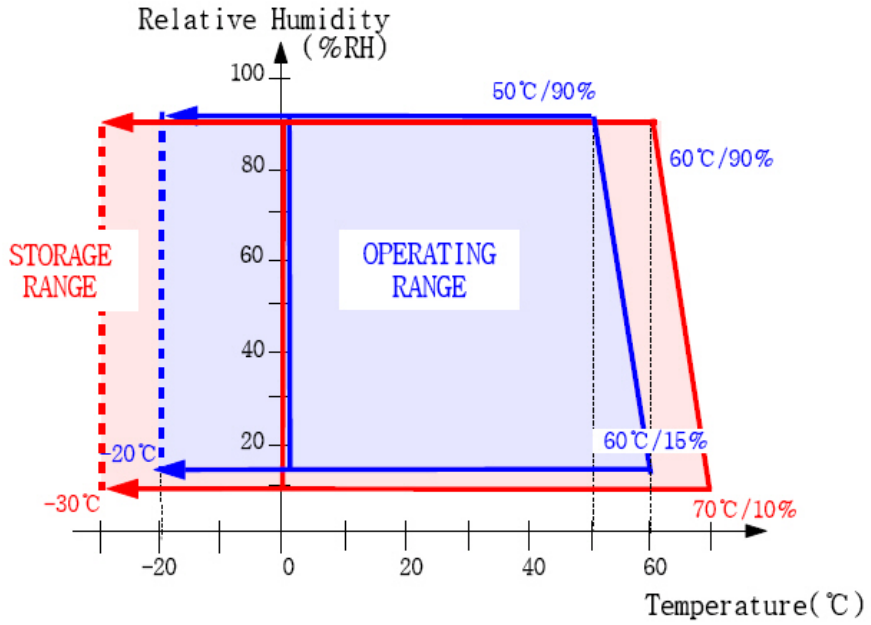
# 1. Absolute Maximum Ratings

## 1.1 Absolute Ratings of Environment

| Item | Symbol | Min. | Max. | Unit | Note |
|---|---|---|---|---|---|
| Storage temperature | TSTG | -30 | 70 | ℃ | (1) |
| Operating temperature (Ambient temperature) | TOPR | -20 | 60 | ℃ | (1), (2) |

Note (1) 90%RH maximum humidity, 60℃ maximum wet-bulb temperature

(2) When operated at a temperature lower than 0℃, the LCD worked slowly and the screen slowed appearing dim images due to the characteristics of LC (Liquid Crystal).




Temperature & Humidity Graph at Absolute Environment

## 1.2 Electrical Absolute Ratings

(1) TFT-LCD Module

(Ta = 25 ± 2°C, VSS=GND=0V)

| Characteristics | Symbol | Min. | Max. | Unit | Note |
|---|---|---|---|---|---|
| External power supply | VDD | -0.3 | 4.6 | V | |

(2) Back-light Unit

(Ta = 25 ± 2°C)

| Characteristics | Symbol | Min. | Max. | Unit | Note |
|---|---|---|---|---|---|
| Current | $I_B$ | - | 25 | mA | (1) |

Note (1) Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded. Functional operation should be restricted to the conditions described under normal operating conditions.

## 2. Optical Characteristics

### 2.1 Transmissive Mode

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (2).

Measuring equipment: BM-5A, BM-7, PR-650, EZ-Contrast

(Ta = 25 ± 2°C)

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| Contrast ratio (Center point) | | C/R | | 300 | 350 | - | - | (3) BM-5A |
| Luminance of white (Center point) | | YL | with TSP | 210 | 280 | - | cd/m2 | (4) BM-5A |
| Color Reproducibility | | Cre | | 45 | 50 | 55 | % | |
| Crosstalk | | | | - | - | 5 | % | (8) SR-3 |
| Response time | Rising:Tr | Tr+Tf | | - | 28 | 35 | msec | (5) BM-7 |
| | Falling:Tf | | | | | | | |
| Color chromaticity (CIE 1931) | White | Wx | | 0.265 | 0.315 | 0.365 | | (6) PR-650 |
| | | Wy | | 0.293 | 0.343 | 0.393 | | |
| | Red | Rx | | 0.540 | 0.590 | 0.640 | | |
| | | Ry | | 0.279 | 0.329 | 0.379 | | |
| | Green | Gx | | 0.289 | 0.339 | 0.389 | | |
| | | Gy | | 0.533 | 0.583 | 0.633 | | |
| | Blue | Bx | | 0.104 | 0.154 | 0.204 | | |
| | | By | | 0.036 | 0.086 | 0.136 | | |
| Viewing angle | Hor. | θL | CR≥10 | 60 | 65 | - | Degrees | (7) EZ-Contrast |
| | | θR | | 60 | 65 | - | | |
| | Ver. | φH | | 50 | 55 | - | | |
| | | φL | | 40 | 45 | - | | |

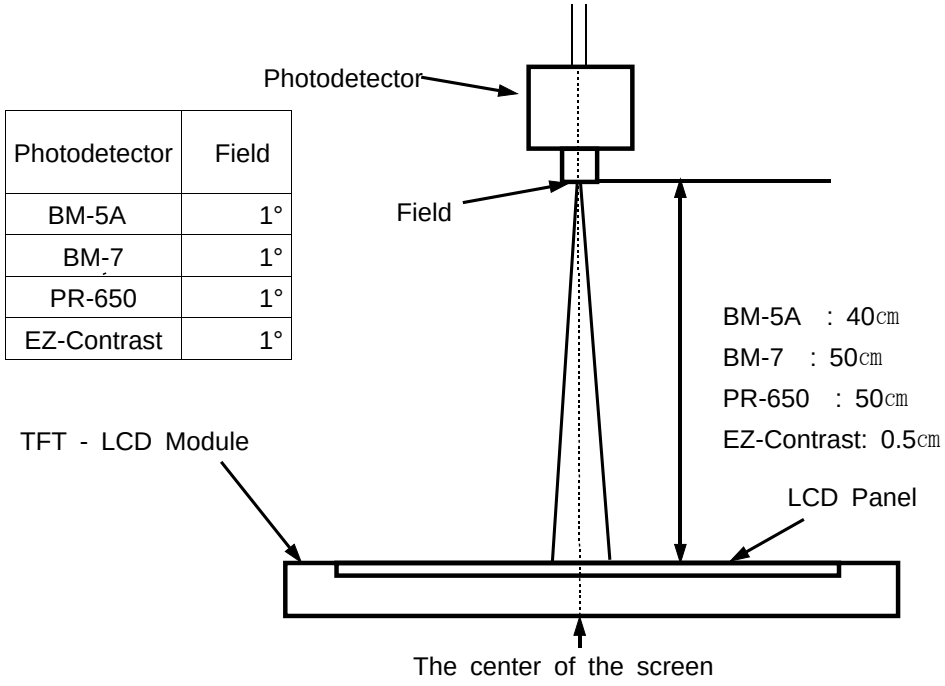
Note (1) If product is exposed to high temperatures for extended time, there is a possibility of the polarizer film damage which could degrade the optical characteristics.

Note (2) Test Equipment Setup

After stabilizing and leaving the panel alone at a given temperature for 30min, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30min after lighting light source. This should be measured in the center of screen.

- Environment condition : Ta = 25 ± 2 °C
- Back-Light On condition

| Photodetector | Field |
|---|---|
| BM-5A | 1° |
| BM-7 | 1° |
| PR-650 | 1° |
| EZ-Contrast | 1° |

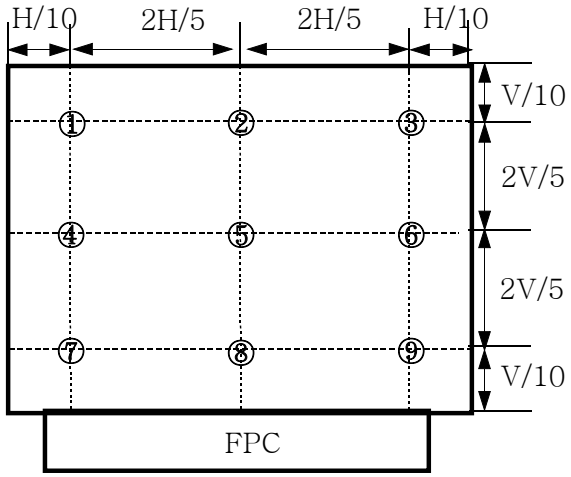



Note (3) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point of the panel.

$$C/R = \frac{Gmax}{Gmin}$$

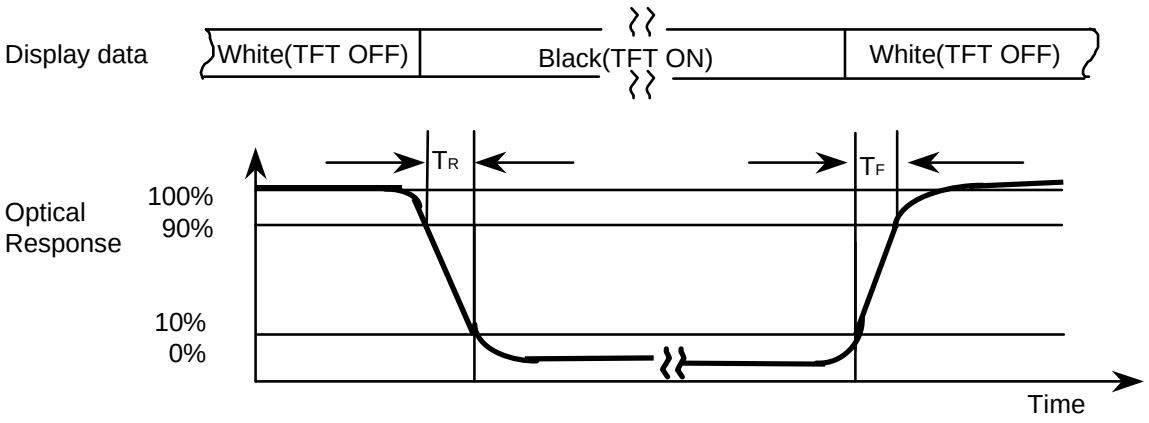
* Gmax : Luminance with all pixels white
* Gmin : Luminance with all pixels black

Note (4) Definition of Luminance of White : Luminance of white at the center point.




The spot locations for luminance measurement

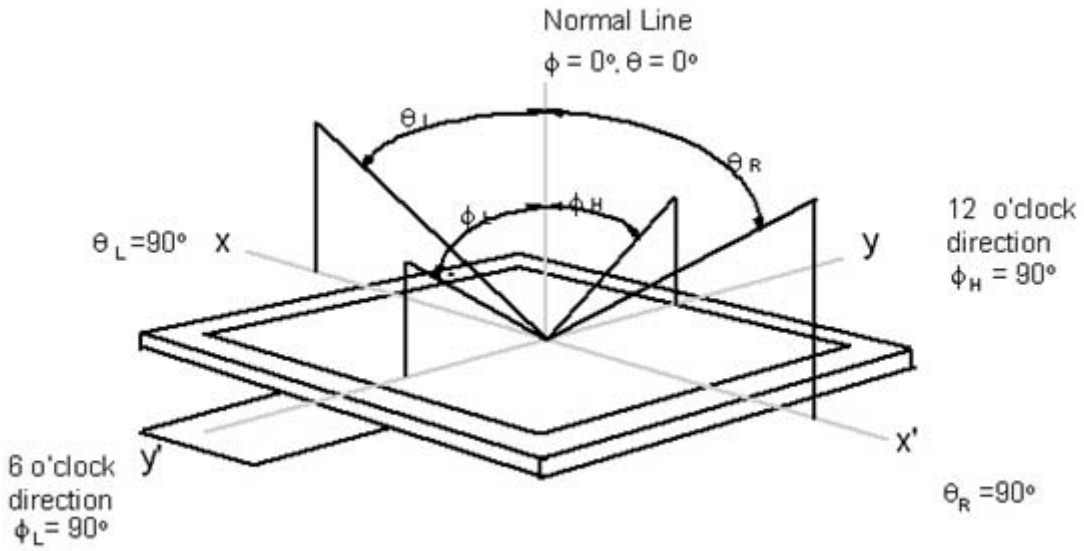
Note (5) Definition of Response time : Sum of Tr, Tf




Note (6) Definition of Color Chromaticity (CIE 1931)

Color coordinate of white & red, green, blue at center point.

Note (7) Definition of Viewing Angle



Note (8) Crosstalk

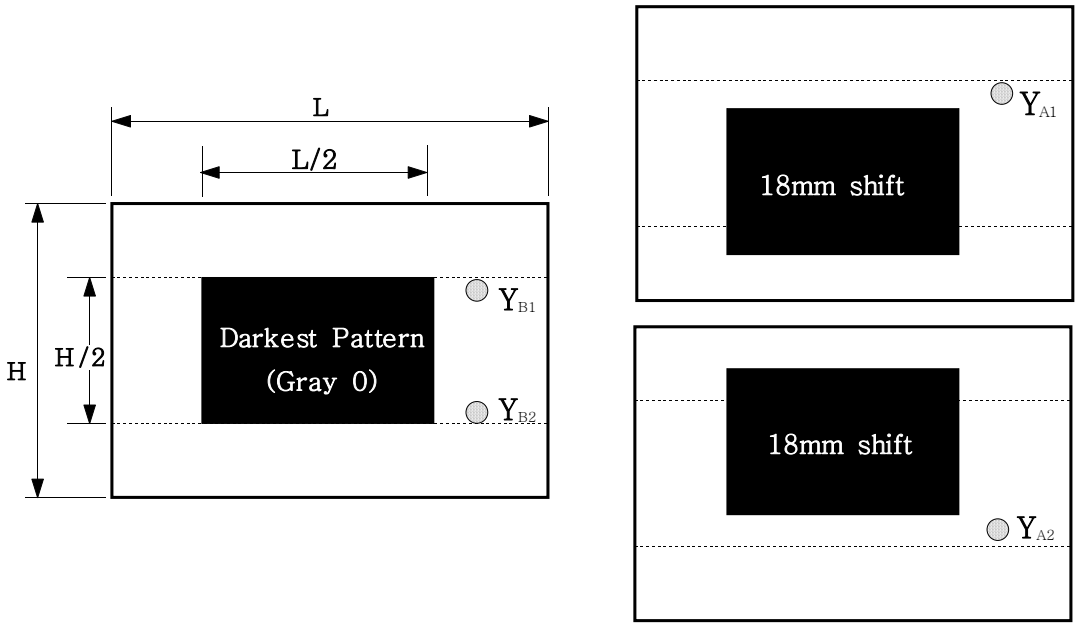
$$\text{Crosstalk Modulation Ratio}(D_{SHA}) = \frac{|Y_A - Y_B|}{Y_A} \times 100\ (\%)$$

Where

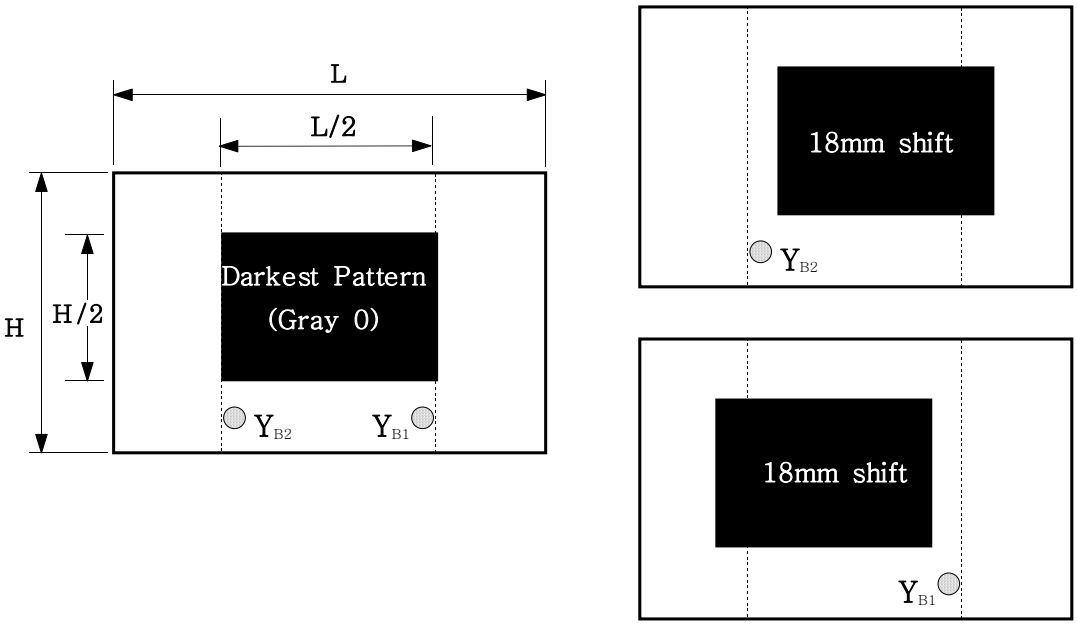
$Y_A$ , $Y_B$ measurement = 2° Viewing Angle (Measurement area ψ12㎜)

The pattern except the Black Bar is a gray 32.

ⓐ Horizontal-Crosstalk measurement method




ⓑ Vertical-Crosstalk measurement method



# 3. Electrical Characteristics

## 3.1 TFT-LCD Module

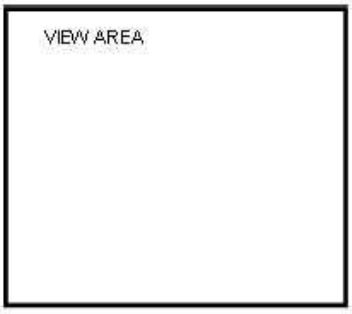
* To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the section 7.3 Power On/Off Sequence.

(Ta = 25 ± 2°C)

| Characteristics | | Symbol | MIN. | TYP. | MAX. | Unit | Note |
|---|---|---|---|---|---|---|---|
| Logic power supply | | VDD | 3.2 | 3.3 | 3.4 | V | |
| Power Dissipation | White | $P_W$ | | 230 | 250 | mW | with 1 chip solution |
| | Black | $P_B$ | | 250 | 270 | | |
| Frame Frequency | | fFRM | 60 | 75 | 80 | Hz | |

* Power Dissipation check pattern

a) White Pattern




b) Black Pattern

### 3.2 Back-Light Unit

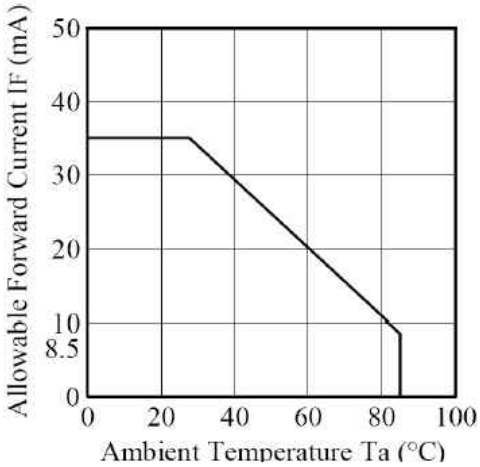
The back-light system is an edge-lighting type with 11 white LED(Light Emitting Diode)s.

(Ta = 25 ± 2°C)

| Characteristics | Symbol | MIN. | TYP. | MAX. | Unit | Note |
|---|---|---|---|---|---|---|
| LEDs current | $I_{BL}$ | | 20 | 22 | mA | (1) |
| Power Dissipation | $P_{BL}$ | | 700 | 770 | mW | (2) |

Note (1) 11 white LEDs

Note (2) Where IB=20mA



# 4. Touch Screen Panel Specification

## 4.1 Electrical characteristic

| Characteristics | MIN. | TYP. | MAX. | Unit | Note |
|---|---|---|---|---|---|
| Linearity | -1.5 | - | 1.5 | % | Analog X and Y direction |
| Terminal resistance | 360 | 847 | 1240 | Ω | X |
| | 160 | 294 | 640 | Ω | Y |
| Insulation resistance | 10 | - | - | MΩ | DC 25V |
| Voltage | - | - | 7 | V | DC |
| Chattering | - | - | 10 | ms | 100kΩ pull-up |
| Transparency | 78 | 80 | - | % | JIS-K7105, ASTM D1003, @550nm |

Caution (1) : Do not operate it with a thing except a polyacetal pen (tip R0.8mm or more) or a finger, especially those with hard or sharp tips such as a ball point pen or a mechanical pencil.

## 4.2 Mechanical & Reliability Characteristics

| Characteristics | MIN. | TYP. | MAX. | Unit | Note |
|---|---|---|---|---|---|
| Activation force | - | - | 50 | gf | (1) |
| Linearity force | - | - | 130 | gf | (2) |
| Durability (surface scratching) | 100,000 | - | - | times | (3) |
| Durability (surface pitting) | 1,000,000 | - | - | touches | (4) |
| Surface hardness | 3 | - | - | H | JIS K7105, ASTM D3363 |

Note (1) Input method : Stylus pen(R0.8mm)

(2) Input method : Individual point on with stylus pen(R0.8mm)

(3) Measurement for surface area

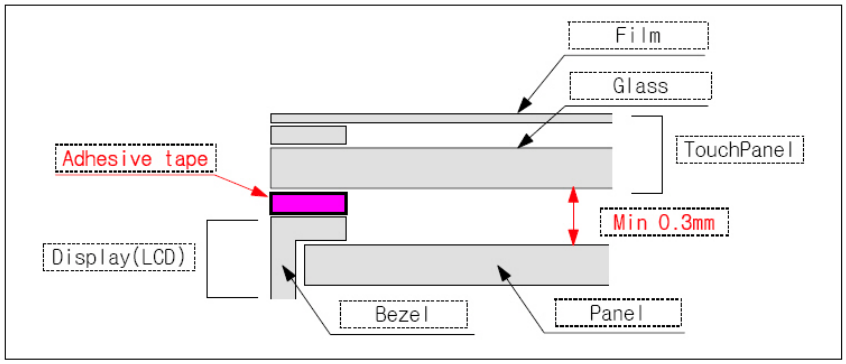
- Scratch 100,000 times straight line on the film with a stylus change every 20,000 times
- Force : 250gf
- Speed : 60mm/sec
- R0.8 polyacetal tip

(4) Pit 1,000,000 times on the film with a R8.0 silicon rubber.

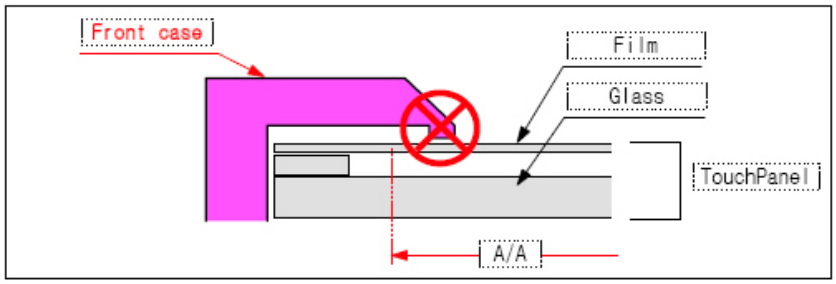
- Force : 250gf
- Speed : 2 times/sec

### 4.3 Design Guide

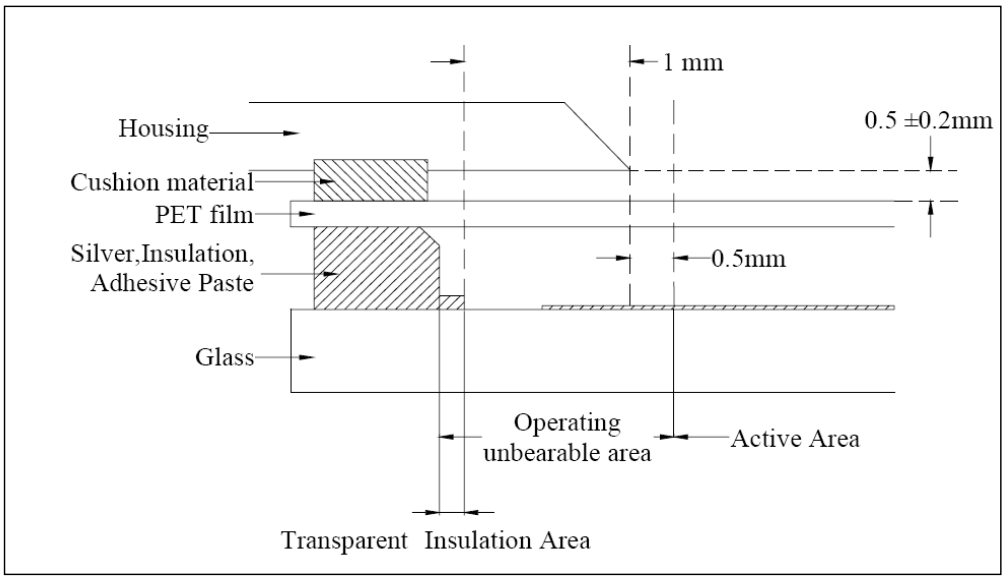
- Give enough clearance (over 0.3mm) between the touch panel and a display device to protect a display.




- Avoid the design that Front-case overlap and press on the active area of the touch panel.
- Give enough gap (over 0.5mm at compressed) between the front case and touch panel to protect wrong operating.



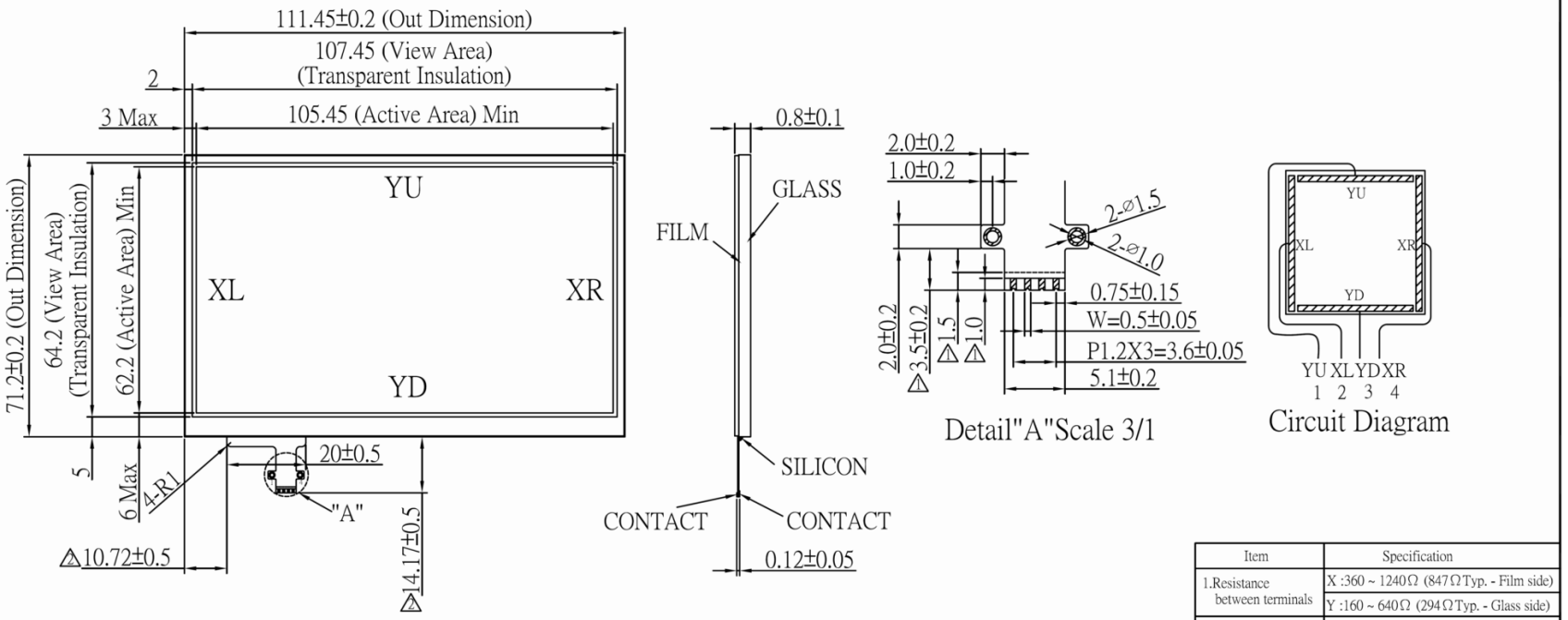

- Use a buffer material (Gasket) between the touch panel and Front-case to protect damage and wrong operating.
- Avoid the design that buffer material overlap and press on the inside of touch panel viewing area.



## 4.4 Outline Dimension

| CUSTOMER NAME | Samsung | CUSTOMER Ref. No. | |
|---|---|---|---|
| CUSTOMER'S APPROVAL | | / / | |

| NO. | Revision Record | Reviser | Date |
|---|---|---|---|
| 1. | ⚠Drawing Revised ( 3 Point ) | Kathy Hsu | 05 / 10 / 07 |
| 2. | ⚠Drawing Revised ( 2 Point ) | Kathy Hsu | 05 / 11 / 07 |
| 3. | | | |




| Item | Specification |
|---|---|
| 1.Resistance between terminals | X :360 ~ 1240Ω (847ΩTyp. - Film side) |
| | Y :160 ~ 640Ω (294ΩTyp. - Glass side) |
| 2.Linearity | ±1.5% ↓ |
| 3.Light Transparency | 78% Min. (80% Typ.) |
| 4.Surface Hardness | 3H |
| 5.Tail | FPC (Copper) |

| Elucidation | 總成圖 | Drive Model | Analog | Approved By | Phil Lin | 01 / 16 / 07 |
|---|---|---|---|---|---|---|
| Panal Size | | Drive Voltage | | Checked By | Phil Lin | 01 / 16 / 07 |
| Viewing Size | | Operating Temp | | Design By | Kathy Hsu | 01 / 16 / 07 |
| Front Material/Thickness | Clear Type/0.18tmm | Storage Temp | | Drawing By | Kathy Hsu | 01 / 16 / 07 |
| Rear Material/Thickness | Glass/0.55tmm | Connector | | Data Reserve | | |

e - FAST
洋華光電股份有限公司
YOUNG FAST OPTOELECTRONICS CO.,LTD.

| Sheet | 1 / 1 | Tolerance | ±0.3 | Unit | mm |
|---|---|---|---|---|---|
| Size | A4 | Angles | ±0.5° | Scale | 1 / X |

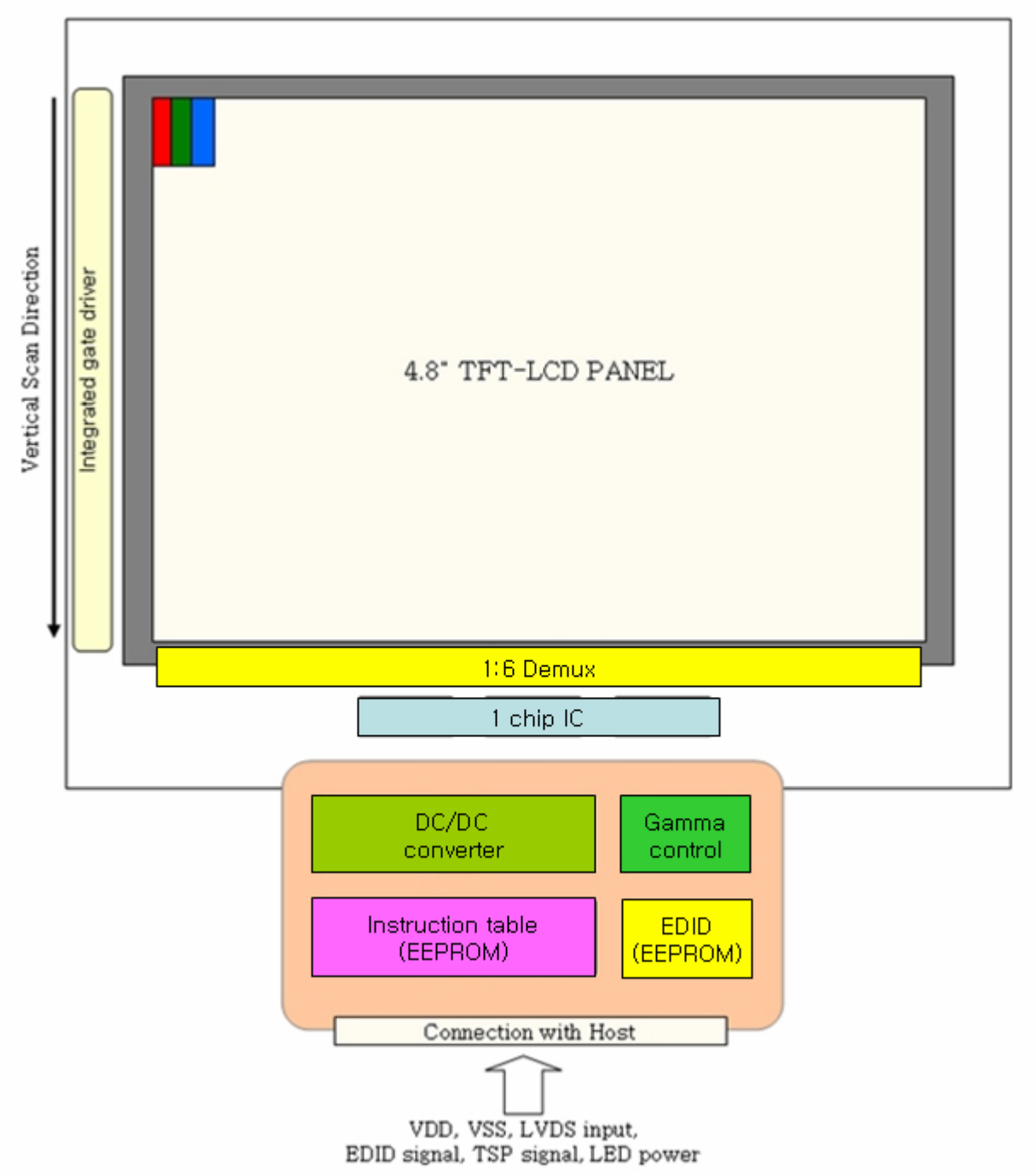
Pro (3)

Model Number: A489B

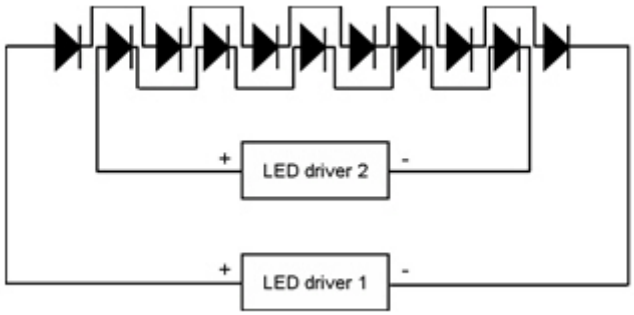
Drawing Number: A489B-01(N2)

# 5. Block Diagram

## 5.1 TFT-LCD Module

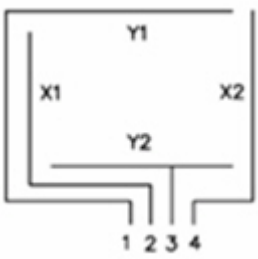


**5.2 Back-Light Unit** (Connector : 4 pin FPC solder type)




| Pin No. | Symbol | I/O |
|---|---|---|
| 1 | VCD1 | LED Power supply (cathode-1) |
| 2 | VAD1 | LED Power supply (anode-1) |
| 3 | VAD2 | LED Power supply (anode-2) |
| 4 | VCD2 | LED Power supply (cathode-2) |

**5.3 Touch Screen Panel**




X : Upper electrode, Y : Lower electrode

## 6. Input Terminal Pin Assignment

**6.1 Input Signal & Power** (Connector type : 30 pin/ 1.0mm pitch/ Bottom contact)

| Pin No. | Symbol | I/O |
|---|---|---|
| 1 | Vdd | LCD Power supply : 3.3V |
| 2 | TSPX1 | Touch screen signal : X_left |
| 3 | TSPX2 | Touch screen signal : X_right |
| 4 | TSPY1 | Touch screen signal : Y_up |
| 5 | TSPY2 | Touch screen signal : Y_down |
| 6 | Vdd | LCD Power supply : 3.3V |
| 7 | Vss | Ground |
| 8 | RxIN0- | Negative LVDS differential data inputs (R0?R5, G0) |
| 9 | RxIN0+ | Positive LVDS differential data inputs (R0?R5, G0) |
| 10 | Vss | Ground |
| 11 | RxIN1- | Negative LVDS differential data inputs (G1?G5, B0- B1) |
| 12 | RxIN1+ | Positive LVDS differential data inputs (G1?G5, B0- B1) |
| 13 | Vss | Ground |
| 14 | RxIN2- | Negative LVDS differential data inputs (B2?B5, Hsync, Vsync, DE) |
| 15 | RxIN2+ | Positive LVDS differential data inputs (B2?B5, Hsync, Vsync, DE) |
| 16 | Vss | Ground |
| 17 | CLK- | Negative LVDS differential clock inputs |
| 18 | CLK+ | Positive LVDS differential clock inputs |
| 19 | Vss | Ground |
| 20 | EDID CLK | EDID clock |
| 21 | EDID DATA | EDID data |
| 22 | EDID PWR | EDID power supply : 3.3V |
| 23 | Vss | Ground |
| 24 | Vss | Ground |
| 25 | VCD1 | LED Power supply (cathode-1) |
| 26 | VCD2 | LED Power supply (cathode-2) |
| 27 | VAD1 | LED Power supply (anode-1) |
| 28 | VAD2 | LED Power supply (anode-2) |

## 6.2 Input Signal, Basic Display Colors and Gray Scale of Each Colors

| COLOR | DISPLAY | DATA SIGNAL | | | | | | | | | | | | | | | | | | GRAY SCALE LEVEL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | RED | | | | | | GREEN | | | | | | BLUE | | | | | | |
| | | R0 | R1 | R2 | R3 | R4 | R5 | G0 | G1 | G2 | G3 | G4 | G5 | B0 | B1 | B2 | B3 | B4 | B5 | |
| BASIC COLOR | BLACK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | BLUE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | GREEN | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | CYAN | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | RED | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | MAGENTA | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| | YELLOW | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| | WHITE | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - |
| GRAY SCALE OF RED | BLACK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R0 |
| | DARK | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R1 |
| | ↑ | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R2 |
| | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | R3~R61 |
| | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | ↓ | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R62 |
| | LIGHT | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R63 |
| | RED | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | R64 |
| GRAY SCALE OF GREEN | BLACK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G0 |
| | DARK | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G1 |
| | ↑ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | G2 |
| | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | G3~G61 |
| | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | ↓ | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | G62 |
| | LIGHT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | G63 |
| | GREEN | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | G64 |
| GRAY SCALE OF BLUE | BLACK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | B0 |
| | DARK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | B1 |
| | ↑ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | B2 |
| | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | B3~B61 |
| | | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | ↓ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | B62 |
| | LIGHT | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | B63 |
| | BLUE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | B64 |

Note) Definition of Gray :

※ Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

※ Input Signal : 0 = Low level voltage, 1 = High level voltage

※ R5, G5, B5 : MSB

※ R0, G0, B0 : LSB

# 7. Interface Timing

## 7.1 Timing Parameters of TFT-LCD Module Input Signals

(a) Vertical timing

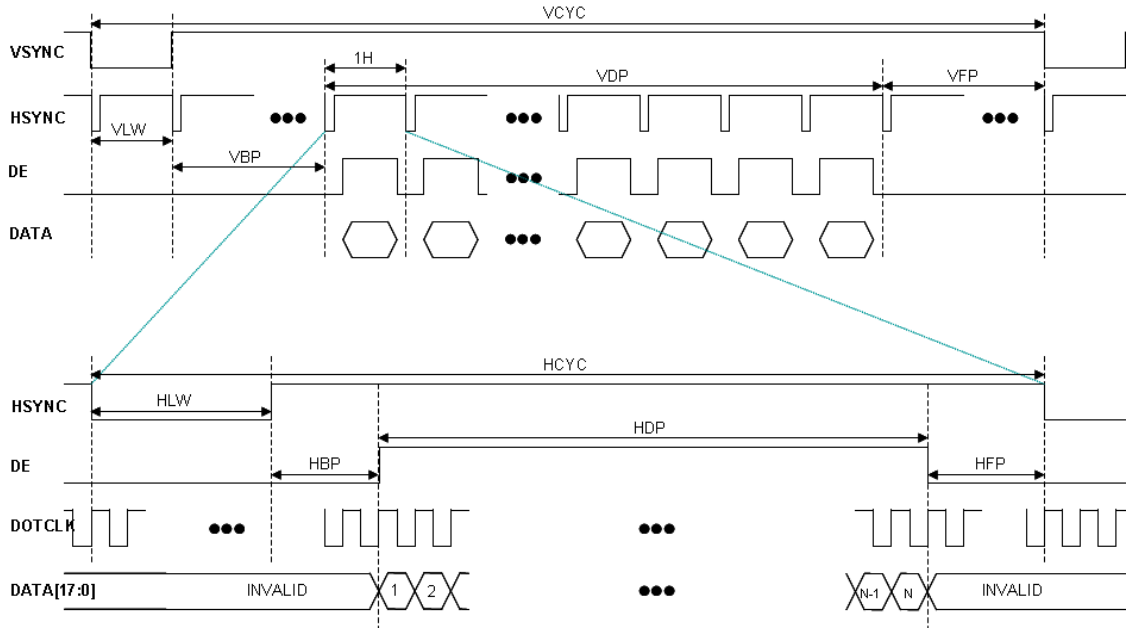
| Signal | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Frame Frequency | $f_{FRM}$ | 60 | 75 | 80 | Hz | (1) |
| VSYNC (Frame) Period | VCYC | - | 608 | - | H | (1) |
| VSYNC Low Width | VLW | - | 1 | - | H | (1) |
| Vertical Display Period | VDP | - | 600 | - | H | (1) |
| Vertical Back Porch | VBP | - | 4 | - | H | (1) |
| Vertical Front Porch | VFP | - | 3 | - | H | (1) |

(a) Horizontal timing

| Signal | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| DotCLK Frequency | $f_{CLK}$ | - | 53.99 | - | MHz | (1) |
| HSYNC (Frame) Period | HCYC | - | 1184 | - | DotCLK | (1) |
| HSYNC Low Width | HLW | - | 32 | - | DotCLK | (1) |
| Horizontal Display Period | HDP | - | 1024 | - | DotCLK | (1) |
| Horizontal Back Porch | HBP | - | 80 | - | DotCLK | (1) |
| Horizontal Front Porch | HFP | - | 48 | - | DotCLK | (1) |

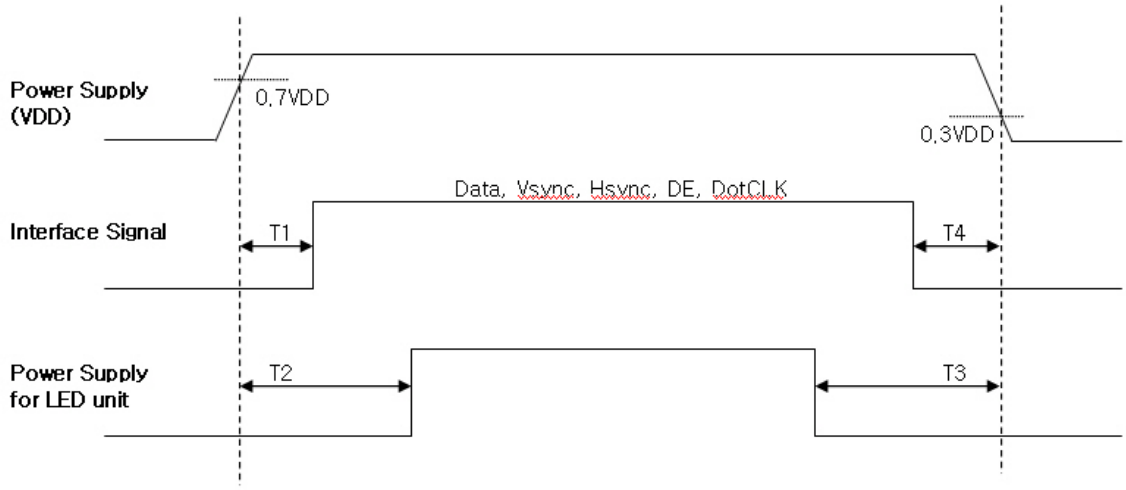
(1) Timing-combinations have been preset and memorized in EEPROM.
When recommended timings are put into LCD, LCD can be displayed without EDID

## 7.2 Timing Diagrams of TFT-LCD Module Input Signals



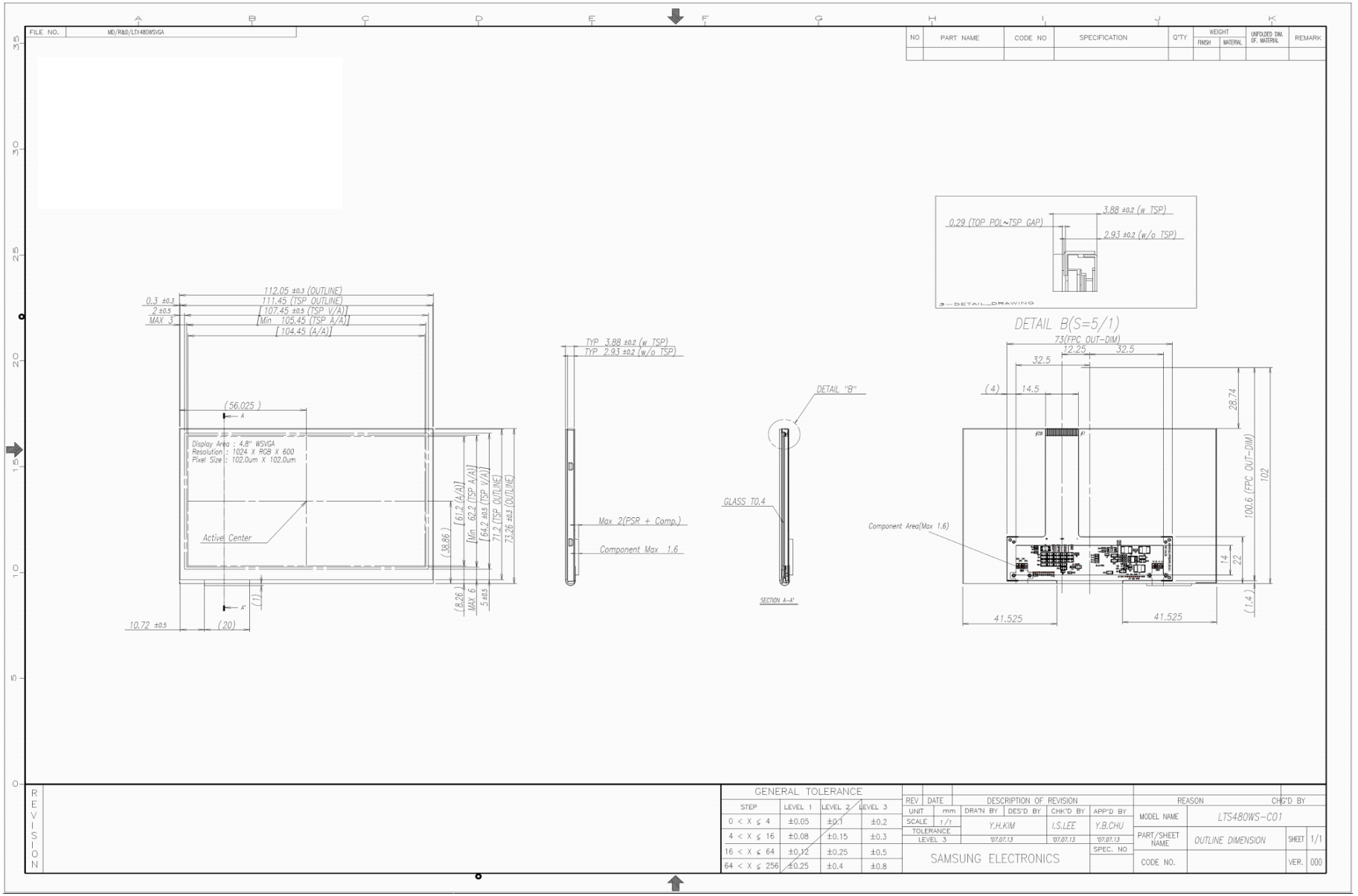
### 7.3 Power ON/OFF Sequence

- To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.

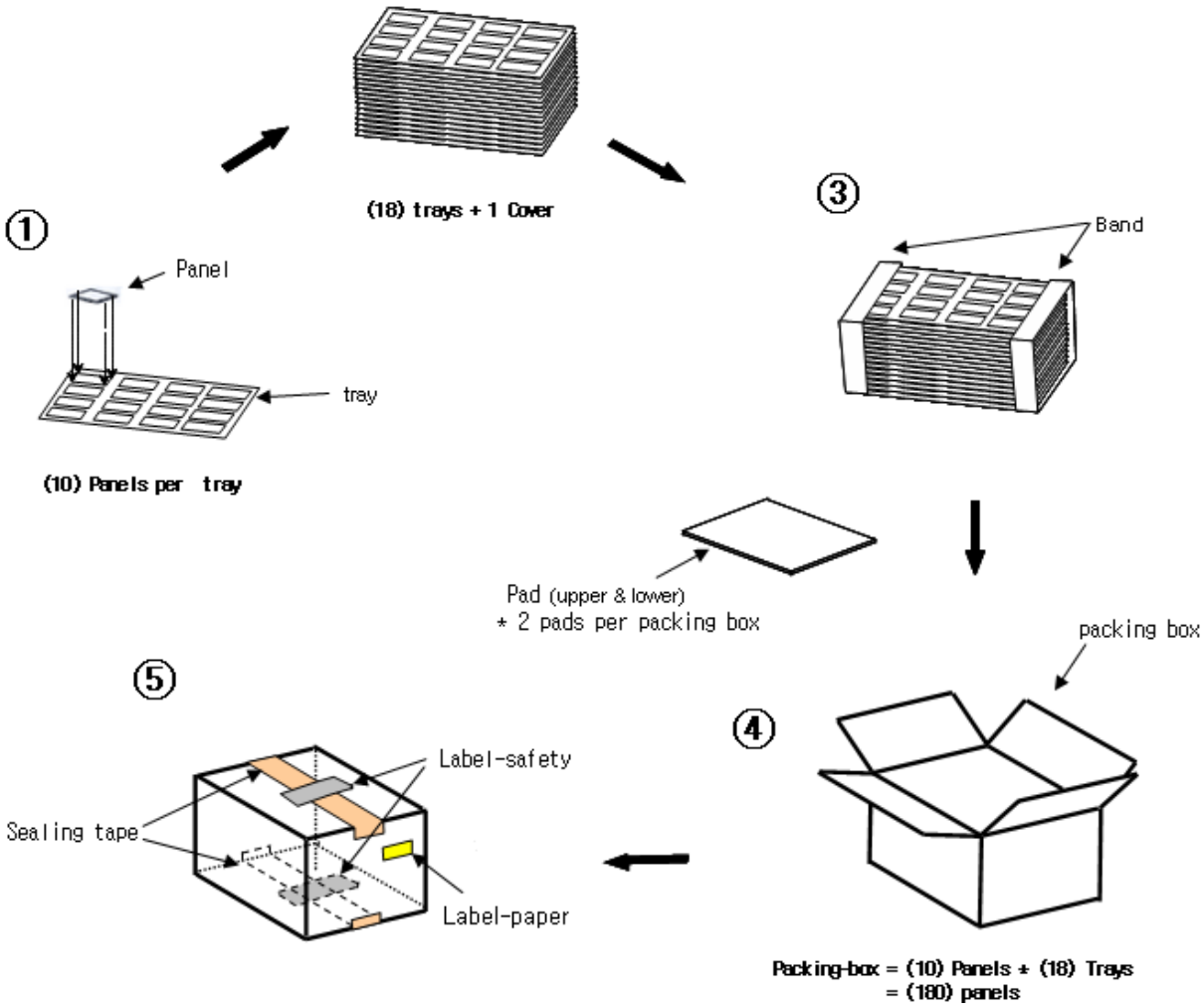



| Symbol | Specification | Note |
|---|---|---|
| T1 | 0 ms < T1 | |
| T2 | T1 + 10 frames < T2 | |
| T3 | T4 + 10 frames < T3 | |
| T4 | 10 ms < T4 | |

## 8. Module Outline Dimension



## 9. PACKING




Note (1) Total : Case: Approx. 3.1 Kg
Box: Approx. 15.7Kg

(2) Size : Case: 490(W) x 342(D) x 58(H)
Box: 505(W) x 355(D) x 312(H)

(3) Place the panels in the tray facing the direction shown in the figure.

(4) Place 4 tray and cover(empty tray) and pads inside the packing-case.

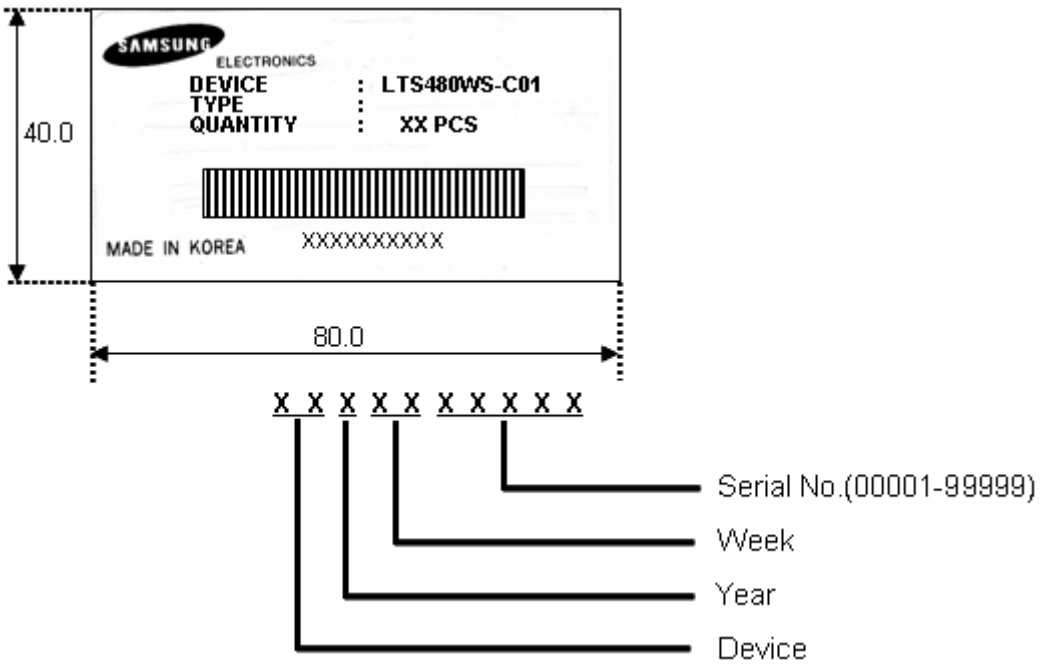
(5) Place 5 packing-case inside the packing-box.(Affix the label)

(6) Seal the packing-box. Affix the label-safety.

## 10. MARKING & OTHERS

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

(1) Packing case attach



# 11. General Precautions

## 11.1 Handling

(a) When the module is assembled, it should be attached to the system firmly. Be careful not to twist and bend the module.

(b) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module and back-light unit.

(c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.

(d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.

(e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.

(f) The desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane. Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethylacid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.

(g) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.

(h) Protect the module from static, it may cause damage to the CMOS Gate Array IC.

(i) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(j) Do not disassemble the module.

(k) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.

(l) Pins of I/F connector shall not be touched directly with bare hands.

### 11.2 Storage

(a) Do not leave the panel in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35°C and relative humidity of less than 70%.

(b) Do not store the TFT-LCD module in direct sunlight.

(c) The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

### 11.3 Operation

(a) Do not connect, disconnect the module in the "Power On" condition.

(b) Power supply should always be turned on/off by the item 7.3 "Power on/off sequence"

### 11.4 Others

(a) The liquid-crystal is deteriorated by ultraviolet rays. Do not leave it in direct sunlight and strong ultraviolet rays for many hours.

(b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.

(c) Do not exceed the absolute maximum rating value. ( the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on) Otherwise the panel may be damaged.

(d) If the panel displays the same pattern continuously for a long period of time, it can be the situation when the image "Sticks" to the screen.

(e) This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.